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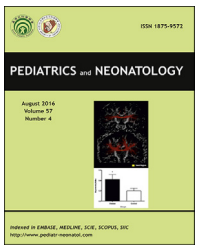

ORIGINAL ARTICLE

Physical Activity in School-Aged Children with Asthma in an Urban City of Taiwan

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Key Words
asthma;
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Background: It has been reported that physical activity is limited in children with asthma. The aims of this study were to compare and quantify the physical activity levels between asthmatic children and their healthy peers. Factors associated with limitation of physical activity in asthmatic children were also investigated.
Methods: A total of 120 asthmatic children and 262 age-matched healthy controls were enrolled in this study. Clinical phenotype including severity and lung function were obtained from medical records. A questionnaire addressing physical activity, asthma diagnosis, symptoms, parental health beliefs, physician's advice and, community resources was accomplished by children and their parents. The physical activity levels of children with and without asthma were compared. Factors that might limit the activity level were analyzed.
Results: Children with asthma were less active than their peers. The significant difference was between normal controls and moderate-to-severe asthmatic children, but not children with mild asthma. Among children with asthma, physical activity was associated with the severity level but not parental health beliefs, physician's advice, or the convenience for physical activity. Children with moderate or severe persistent asthma were more likely to be inactive.
Conclusion: Children with asthma had a lower level of physical activity, particularly those with moderate-to-severe asthma. To achieve an appropriate level of physical activity, improvement of asthma management and control is considered important.

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1. Introduction

Asthma is a chronic inflammatory disease of the airway that results in recurring acute and chronic recurrent episodes of breathing problems such as coughing, wheezing, chest discomfort, and shortness of breath.[1] These episodes can be mild, moderate, or even life-threatening, requiring intensive care and causing great morbidity and mortality.[2] Some children experience symptoms only when they exercise,[3] and vigorous exercises often cause symptoms for most children with asthma if their asthma is not well controlled.[4] The maintenance of normal function allowing asthmatic children to participate fully in physical activities is one of the goals of modern asthma management.[5]

Physical activity is important for the development of good health and fitness habits in children,[6,7] and participation in physical activity is an important part of children's normal psychosocial development and self-image.[8,9] It has been considered that the physical activity level in children with asthma is limited in comparison to their peers. The physical activity level of children with asthma varies in different studies. A survey of schoolchildren in the United States found that children with asthma are less active than their peers,[10] whereas other reports found that asthma did not prevent children from overall participation in exercise[11] or even that they were more active than their peers.[12] Some factors, such as effect of asthma treatment, may influence daily physical activity in asthmatic children.[13]

The objective of this study was to compare and quantify the physical activity levels of children with and without asthma. We further investigated the relationship between clinical phenotype and the level of physical activity. Factors that might influence and limit the physical activities in asthmatic children were also explored.

2. Methods

2.1. Patients

One hundred and twenty asthmatic children, aged 8—12 years, were recruited from Taipei Dungmen Primary School ($n = 94$; 78.34%), outpatient department of allergy in National Taiwan University ($n = 6$; 5%), and from the Asthma Festival held in Taipei City ($n = 20$; 16.67%). The asthma case was defined using the criteria established by the National Asthma Education and Prevention Program guidelines.[14] Children were considered to have asthma if diagnosed by a physician or if the child had had some asthma symptoms such as episodic wheezing, breathlessness, night cough, and varying airflow obstruction during a lung function test in the past 12 months. Asthma severity classification is determined by the four steps described by the National Asthma Education and Prevention Program guidelines using reported frequency of day symptoms, night symptoms, and lung function test during the past month.[14]

2.2. Healthy controls

Two hundred and sixty-two healthy children were enrolled as the control group. They were recruited from the same school, Taipei Dungmen Primary School. To exclude the possible bias of differences in cardiopulmonary fitness due to a different degree of baseline conditioning, healthy controls were matched to the asthmatic children in terms of age, height, and weight. The healthy control group had no history or clinical evidence of asthma, atopy, or other respiratory disorders.

2.3. Questionnaire

A structured, 30-item questionnaire, designed by the Department of Physical Medicine and Rehabilitation of National Taiwan University in 2004, was administered to the children enrolled in this study, which addressed physical activity, asthma diagnosis, symptoms, parental health beliefs, physician advice (supported or discouraged), and community resources (lived within walking distance of a place for exercise). Questionnaires were then collected for analysis. Physical activity was evaluated in the total minutes active on 1 day and the number of days active in a typical week in the past year for each child enrolled in this study. To assist in recall, the parents were asked how many minutes their children spent on each of the specific activity on the list. The list included sports, active games, and activities such as walking, running, and climbing stairs. Unlisted activities could be added by the parents. To improve accuracy of recall, the parents were asked to complete the questionnaire together with the children. The interview of physical activity was pilot tested for same-day test—retest reliability on volunteer parents from the outpatient department of National Taiwan University Hospital by administering the same questionnaire twice.

2.4. Metabolic equivalent of task calculation

The metabolic equivalent of task (MET) is a physiological measure for the cost of energy in physical activities, and it is expressed as the ratio to a standard resting metabolic rate, set by convention to 3.5 mL O_2/kg/min. Energy expenditure in MET-hours, kcal, or kcal per kilogram body weight can be estimated for specific activities by type or MET intensity. The MET intensity of each activity was obtained from the compendium of physical activities.[15] A mean MET-hours score was elaborated from the questionnaire according to the type and duration of recreational and sporting activities in the past 1 year. Matching the children of the two groups was done to exclude the possible bias of difference in cardiopulmonary fitness owing to a different degree of baseline conditioning.

2.5. Demographic analysis

Demographic items including age, sex, weight, and height were obtained. Lung function tests including flow-volume curves, forced vital capacity (FVC), and forced expiratory volume in 1 second (FEV1) were also measured.

2.6. Exclusion criteria

Exclusion criteria included major medical conditions such as neuromuscular problems, congenital/acquired heart

disease, and recent injuries that would possibly influence and limit physical activities. Patients who suffered from clinically apparent respiratory tract infections during the time of the study were excluded. Patients who had an exacerbation of asthma, which was defined as having symptoms requiring asthma-related emergency department visit, asthma-related hospitalization, or asthma treatment with a short course of oral corticosteroids, during the past 2 weeks were also excluded.

2.7. Statistical analysis

Statistical analysis was performed using IBM SPSS statistics (version 19; IBM, Armonk, NY, USA). Student *t* test was used to determine the difference between normal controls and asthmatic children in demographic characteristics including age, height, weight, FVC, and FEV1. Physical activity levels expressed by MET-hours were compared between normal control and asthmatic children, or between subgroups by severity in asthmatic children using Mann–Whitney *U* test. Factors associated with inactivity in asthmatic children were determined by Chi-square test and by calculating the odds ratio. Parental health beliefs and physician's advice for exercise among normal controls and asthmatic children were compared using the Chi-square test. Results were considered significant at $p < 0.05$.

3. Results

3.1. Demographics

In the case–control study population, including 120 asthmatic children and 262 normal controls, there was no statistically significant difference in age, sex distribution, weight, or lung function tests between asthmatic children and healthy controls, except for height (132.9 ± 11.7 cm in asthmatics vs. 147.8 ± 14.9 cm in controls; Table 1).

3.2. Asthmatic children were less active than normal controls

In the study population, severity classification of asthmatic children was 55% ($n = 66$) in the mild intermittent group, 25% ($n = 30$) in the mild persistent group, 14.2% ($n = 17$) in the moderate persistent group, and 5.8% ($n = 7$) in the severe persistent group. Children with asthma were less active than their peers. Activity scores were 6.985 ± 1.261 (mean ± standard error of the mean) for asthmatic children and 8.878 ± 0.9242 for their normal peers ($p = 0.002$). Within the asthmatic group, higher activity level was found in children with mild asthma than those with moderate-to-severe asthma. Comparison between children with mild asthma and controls showed similar activity levels. This implies that the physical activity and asthma severity classification are significantly related (Figures 1A and 1B).

Table 1 Demographics analysis.

	Asthmatics ($n = 120$)	Controls ($n = 262$)	*p*
Sex (M/F)	63/57	137/125	NS
Age (y)	11 ± 2	11 ± 2	NS
Height (cm)	132.9 ± 11.7	147.8 ± 14.9	0.01
Weight (kg)	34.5 ± 9.5	42.6 ± 9.4	NS
FVC (% pred)	95 ± 11	93 ± 9	NS
FEV1 (% pred)	95 ± 11	95 ± 9	NS

Data are presented as mean ± SD.
F = female; FEV1 = forced expiratory volume in 1 second; FVC = forced vital capacity; M = male; NS = not significant; SD = standard deviation.

3.3. Factors associated with inactivity in asthmatic children

Next, we investigated the possible factors that may influence the activity of asthmatic children. For this analysis, total minutes of physical activity were classified into inactive group if the physical activity is less than 30 minutes per day.[10] We found that the severity (moderate and severe) was associated with inactivity in asthmatic children with an odds ratio of 3.2. However, physician advice about exercise and walking distance to place for exercise were not significantly related to inactivity of asthmatic children (Table 2).

3.4. Parental health beliefs and physical activity in asthmatic children

Overall, 11% and 25% parents of asthmatic children and normal controls, respectively, agreed that exercise might worsen asthma. However, the difference was not statistically significant. Interestingly, the frequency of physician advice about exercise is significantly less in asthmatic children (23%) than in normal controls (40%; Table 3).

4. Discussion

In the present study we quantified and compared the physical activity levels of urban school-aged children with and without asthma. We found that children with asthma had lower physical activity than their normal peers, and disease severity influenced the inactivity in children with asthma. Although physician advice about exercise was less frequent in children with asthma than their normal peers, it was not an associated factor for inactivity in children with asthma.

During uncontrolled status or exacerbation of asthma, bronchial constriction leads to a sensation of suffocation. Accordingly, asthmatic children and their parents are reluctant to engage in physical activities because of this discomfort, making those with asthma proportionally more prone to being physically inactive.[16] This may be an important reason that physical activity levels were lower in children with asthma in our study. In a recent study, health perception of the parents was found to be associated with the activity level of children with asthma.[17] Parents agreed that exercise was hazardous to asthmatic children and therefore restrained their children from engaging in physical activity.

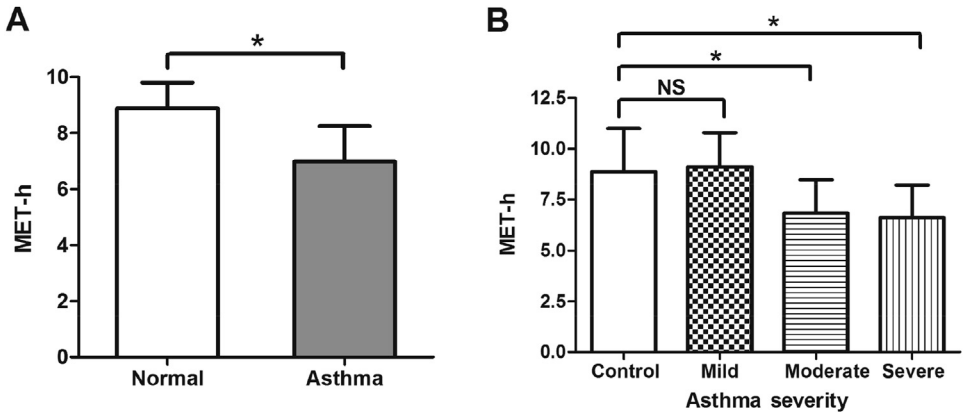

Figure 1 Physical activity levels among the normal control and asthmatic children. (A) Physical activity level was significantly lower in asthmatic children than in their peers. (B) The significant difference was between control and moderate/severe asthmatic children, but not mild asthmatic children. *$p < 0.05$. h = hours; NS = not significant.

Table 2 Factors associated with inactivity in asthmatic children.

Characteristic	Inactive (%; $n = 30$)	Active (%; $n = 75$)	OR (95% CI)
Moderate or severe persistent asthma	65	33	3.2 (1.5–8.4)
Physician's advice about exercise	57	55	1.1 (0.4–1.9)
Walking distance to Place for exercise	85	83	1.1 (0.5–2.8)

CI = confidence interval; OR = odds ratio.

Considering the motivations for a children to be active, perception and convenience for exercise[18] may be as important as objective observation. A study examining behaviors and attitudes related to physical activity and asthma found that motives for performing exercise or sport were similar in asthmatic children and their peers, although asthmatic children perceived less pressure to be active from parents or teachers in school than their peers.[19] Similarly in our study, asthmatic children seemed to have less pressure (less frequent advice) from their physicians about being active for exercise. However, the frequency of physician's advice for exercise was not different between active and inactive asthmatic children. In the present study, we found that most parents in this study reported living within walking distance of a place for exercise. However, from the response of the questionnaire, it seems that not many children actually used them regularly. There was no significant difference in the convenience between the active and inactive groups of asthmatic children. The severity of the disease was still the most important factor affecting the physical activity of asthmatic children.

Table 3 Frequency of parental health beliefs among asthmatics and controls.

	Asthmatics (%; $n = 111$)	Control (%; $n = 243$)	p
Exercise may make asthma worse	11	25	NS
Physician's advice about exercise	23	40	<0.05

NS = not significant.

In conclusion, our study demonstrated that the overall physical activity in urban school-aged children in Taiwan was less active than their peers. A significant difference of physical activity level was found between the healthy controls and children with moderate/severe asthma, but not those with mild asthma. Although children with asthma receive advice for exercise less frequently than their peers, disease severity—but not physicians' advice for exercise—is the major associated factor contributing to inactivity of asthmatic children. These results suggest that asthmatic children can achieve a level of physical activity similar to that of healthy children if an appropriate control of asthma is provided. A recent study for exercise conditioning in patients with asthma emphasized that even by different methods and outcome measurements, the capacity of asthmatic children to exercise safely and significantly improve their pulmonary function,[20] cardiovascular fitness, and quality of life.[21] To improve health outcomes for asthmatic children by getting involved in appropriate physical activity, education about asthma to achieve well-controlled status is considered an important issue for children, their parents, and physicians.

Conflicts of interest

All authors declare no conflicts of interest.

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